[illegible] [illegible]

NEW NEED OF EXPLICITNESS

EXPLICIT
decisions
wh
gotta be made,
can't be let lie or settle

Esp. computer programs

AND YET THE LIKELIHOOD
of
~~not~~ non-explicit
interrelations & influences
⇒ CARELESS & POLITICAL choice

Prob of INFO COLLECTION
ACCESS
leave-around procedures

GRACELESS OPTIONS
of who knows,
sees & is
influenced by
what.

Note: our big diff; coming psychological change
... huge mainly on BREAKDOWN OF
OLD DISTINCTIONS.

Hypnotized — sober
Alive — dead
Same person — new person
Human — non-human
Sentient — non-sentient

NORX-ACTN

Design ...
lists ...
kept, etc.
AUTOMATIC

Let us take the example of the automatic telephone exchange. The automatic telephone exchange, now in prototype operation, can do the following things: connect a calling telephone to the number called; block or re-route the call according to the previoua instructiona of the person at the called number; unite any number of telephone lines for "conference calls"; check and repair itself, all in milliontha of a second. The system ia not finished. One of the problems facing the phone

[Vr]

3

company is that of what kinda of functions it should be programmed to perform. Any system of connections, re-connections, indicators signals (like the ringing of a phone and the busy signal,) are posaible. What kinda of auch aervices should it provide, and when? And what should it charge for which? The overhead is the aame. But there are more sinister possibilities What provisions should be installed for wire-tapping? And by whom? And should be signalled when the wiretap ia performed? ~~The supervisor?~~ The home office? SHould calls be counted? Should a recprd be kept of who calla whom? Such records are useful for the company's own traffic studies. But who else ahould have access to them? How long should it be kept before destruction? The sending of obscene messages-- that is, speaking dirty words in interstate calls-- is illegal. Machinea can be built now to monitor all calls and record the occurrence of obscene words./ Similarly, the content of measagea could be mechanically analyzed for political content, and recorda kept of who says what kinds of things-- ~~also~~ automatically, (with some error, of course,) by machines that exist today.

To avoid bothering the police about this, simple puniahments-- auch aa the interruption of disturbance of phone service-- ~~can~~ could be instituted automatically.

~~We dwell on this extreme example because it does not seem so extreme to us; rather,~~ This example it is the paradigm for our way of thinking about the world's emerging condition. The fact that machines are not everywhere monitoring our every movement, and that no one intenda to put such systema into operation, ignores the fact that systema with these capacitiea, for relatively innocent uaea (to be aure,) are coming into univeraal operation. For instance, the decennial cenaua is taking vaater and vaster information about the movement of population and their lives; the information ia kept whole, and the histories

[Vr]

4

and movementa of individuala/[mechanically] traced for tabulation and analysis. More importantly, Census information ia, of course, privileged communication, and unavailable to other agenciea and persons except in very groaa forms. ~~Moreover,~~ Considerationa of cost and politeness limit the accuracy with which theae investigationa may be puraued. But it must be observed that these are intramural safeguards, backed by Congress but handled only by people.

blacklisting & fire listing ... NAT'L IDENTITY CARDS

SYSTEM INTERLOCK

~~First we must talk about the technical possibilities that have come about.~~

The design and versatility of systems-- systems for doing anything-- has reached an abruptly different stage. Whole dimensions of purposes and possible ends are a part of planning today; and (although the phasing and operations-research aspects of developmental programs do not see it that way) all features of possible contingencies can, in some sense, be called to mind when systems are being designed.

A new generality of planning ability, then, has come into existence; not only the things a system is meant to do, but the things it *might* do, its relations to systems that might come to exist, the phases and currencies and signal-systems and divisions of function that might be planned into it-- all are available as considerations for the planner. The development of automatic data-processing is at the heart of this, but the results are far from revealing themselves yet.

INTERLOCK

The interweaving of systems with one another is of the utmost importance. 71

We have talked in earlier chapters of the limitless possibilities for system design. There was an optimistic quality about that discussion which we now wish to repudiate. We said first that Considered in the abstract, with full machine shops and everything in the world to design, the capacities and interactive properties of the things that can be made are miraculously broad. We then went on to emphasize, contrarily, that the existence of things and situations in motion cut these options to a fraction, reducing the possibilities and capacities of the things that can be done enormously. In practice many decisions-- hasty and capricious-- are deep-seated and irreversible, conditioning developments forever afterward. The site chosen for a city determines where that city will remain, and by development, what difficulties will exist for those who live there. The decision to set off "Project Needles" in 1961 has consequences, not yet determined, for radio astronomy. The decision to use certain bands of the spectrum for

~~3x: DECISION CONSIDERATIONS ARE NOT PARALLEL-- there comparability is forced~~

radio and television systems has important consequences for the future development of other, only dimly foreseen, communication netw orks.

The interlocking of enterprises of this kind, and the depth and diversity of consequences for other, later systems, is of the gravest importance.

These systems have consequences, of course, not merely for various and scattered other systems, but for the fabric of our lives. Television, licensing and supervision procedures, even the basic decisions of long ago that made possible only a few television channels-- all have drastic "effects" on our lives-- though how far one can call a thing an "effect" if it is just an unrealized possibility is questionable.

Many past and future decisions of this kind seem arbitrary, or would have been different had the possibilities been known. Let us briefly examine what we consider to be the situation surrounding decisions today,

INTERLOCK
&
DEGEN. OF SKX

70

Use of machines — telephone
now part of life
Generalization: all things
~~[illegible]~~ in some sense
plannable, integrable
Max & [illegible] modular [illegible]

EMPHASIS [illegible] 'equivalences'
~~[illegible]~~s of pol. [illegible]
systems & their very
different [illegible]
consequences — [illegible]
DIFFERENCE
a growing parameter.

2. NORX: SYSTEMS INTERLOCK
& MACRO-DECISION PROCEDURES
TOMORROW.
Carbon dioxide, silting of lakes, use of bombs,
city planning & transportation, market structure,
subsidy... [illegible] of species, preservation of [illegible] [illegible],
[illegible]

Gene[illegible] d terior ~~[illegible]~~ation

THE EASE OF DRAY in a degenerating situation
(e.g. left-hand drive)

Chemical
→ ALLERGIES
water

Increase of in[illegible] extent,
interlock economies & temptations;
~~decrease in [illegible] conditions~~

STANDARDIZATION

Ω MODULARITY
[illegible]

STAIRS

GEN[illegible] OF
TRAN[illegible]

#OR X

The gradual corruption of universals (accounting systems, axes)

DAYLIGHT SAVING TIME
as ex.

[illegible]

trafic

You [illegible]
sudden[illegible]
[illegible]
can be [illegible]
complet[illegible]
area[illegible]

This generality of consideration often

~~[illegible]~~,

~~[illegible]~~ paralyzes steps in any direction, and then again it increases the danger that any stepp toward dėcisions will have committed us in undesirable ways.

In many ways our old schematics of doing are breaking down.

Administrative boundaries in geographical areas, for instance, multiply, along different lines for functional, historical and political reasons. (Recent studies have placed particular emphasis on Greater New York as an example.)

Problems ... interlockingness

Kinds of decisions

Rather, we are concerned about the range of option that is growing, in all its spread and intricate versatility; we mean to insist that these changes are bringing into possibility new eras of decision, in which the character and extent of these decisions is of the utmost importance; we are most concerned about the distribution of these decisions, the character of systems of evolving decision, and the kinds of things that must never be decided.

NORMATIVE

~~GENORX: DHW~~

Chapter Eleven.

STRANGE HORIZONS, OF DECISIONS AND PLANNING.

In this chapter we want to spread out, and apply some of our ideas to the coming world. We say "the coming world" because we believe the world is changing drastically, in ways bizarre and hard to discern. We do not believe it is possible in any reasonable context to think twenty years ahead, to expect anything to remain much the same. We would like to talk about some of these changes, trying to communicate our sense of urgency and Apocalyptic potentiality. The writer whose sense of urgency most approaches ours is Herman Kahn; but we wish to talk about stranger and more remote things.

The new flux of possibilities we foresee call into question and review ~~not only~~ every possible plan and way of doing things we now know, but-- more basically-- the whole scope of hopes, sentiments and carings of the human life we know. The philosophical model we have traced earlier may seem remote from this discussion; it will appear here and there, with some explanations, but will no longer be the focus of our concern.

Apocalyptic

1. CHANGE

make all core

people-systems, ways of doing

SEE WHAT'S COMING

REVISE IDEAS

CATCH UP

It is our general contention, ~~however,~~ that the world is changing in such a ways that the old schematics are no longer applicable. The distinctions and divisions between my pussycat and your garden, between my fist and your nose, no longer have applicability in a world of fumes, byproducts, enormous undertakings that interact with other enormous undertakings, risks to B incurred by A, and vastly capable systems of manipulation and control.

In ~~these~~ many ways changes are coming about that can only undercut the old ways we used to think of ~~things~~.

Sets of interlocking behaviors

2

[illegible]

1

[illegible]

THE NECESSITY OF PROCEEDING WITH A CONTINUITY OF IDEA- [illegible]

NB [illegible]

57 C1.

1A ARGUMENT, DOCTRINE, IDEA-SYSTEM

FENX questions & rebuttals

COMMITMENTS
CHANGE, within system

PLANNING & DECIS. 'UNITY'

Unifying a command — the number possible arms, tools, facilities as well as duties & consid[illegible] some get slighted.

[illegible]

IMC terminal

SYSTEM [illegible]

Skx ?

Many things are impossible unless all transitional stages [illegible] their development.

e.g., [illegible] [for be continually suitable] during evolution of species.

NORX — Design of organism

[illegible]

[illegible] media?

What [illegible]?

How [illegible]?

What environmental? responses

4 NORX 11

SOME OLD GENERAL CONSIDERATIONS [from SKX to NORX]

We would now like to turn to some of the more general features of these writings, and explain how these considerations of systems analysis fit the earlier model.

It will be recalled that we use the term "schematic," rather ambiguously, to apply to any division into parts or frameworks for description, and to any sets of criteria or measurement. We have been treating schematics, not fixed at a moment in time, but as parts of changing networks of description and interacting reference. In the correspondence of a predicate to several sets of things we have sought criteria for unity, (As well as 'thingness' and construct validation in the technical sense.) We have wanted to know when the application of these schematic networks was suitable, justifiable or appropriate; but we have come to search for the criteria of appropriacy in the relation of these networks to various sets of phenomena which differ for different kinds of studies.

While there is no room to explain the application of these principles to system design in detail, the following points may be made:

The unity of a domain on which systems analysis is appropriate is a function in some way of its sensitivity to further marginal "reconsiderations." If reconsidering further, more far-flung aspects of the problem at hand drastically revises the indicated decisions, then clearly it is not "unitary" in the sense that a Chinese puzzle is. (There may be clearly indicated solutions, or strict techniques toward a solution with the framework as it can best be narrowed, or awfully good ways of proceeding, but that is another matter.)

The currencies and "monies" used for estimation may be unstable. We have not paid much attention to the use of weightings and measures in design and choice, so we will not devote space to it here. However, when these weightings are used-- particularly "utilities" and ordinal estimates of preference, though perhaps even probabilities can be subsumed here-- they are subject to all the philosophic criticisms of measure theory that the schematic model applies to indices, for instance, in social science: they may not measure what we think they measure, or what we are assured they measure in another context; to the extent that they are precisely defined, they may be incapable of registering extra-schematic changes.

Perhaps most importantly, though, any pre-existing schematics may themselves be unstable. That is, if we have pre-assigned certain areas of competence to devices, subsystems, agencies, etc., we may be altogether mistaken about how necessary this schematizing is. There is more than one way to skin a cat, that is the main point; and to be inflexible in the types of tools one expects to use, or even to be sure one wants a cat-skin at all, may hamper you severely in any number of ways.

Although there is an evolution, alluded to previously, from "thing" planning to "system" planning, related roughly to the increasing generality of thought,

~~It should be pointed out that we~~ renounce any theory of the evolution of types of system.

There is no reason to suppose any tendency toward increasing modularity or interlock, as a principle of reasonable behavior when confronted with a system-design problem. The fact that modularity has been increasingly popular in commercial architecture, for example, is based on the particular kinds of use involved, the economics of building, and the constitution of the architectural profession and division of labor.

(As a detailed counterexample, we are interested in the design of a house which is completely amodular -- where the following leading modular decisions would all be rescinded: flat walls and floors, movable furniture, in-the-wall wiring, combination of functions of light and ventilation (window), combination of function of social closure, wind closure and burglar closure (door). In the particular design under discussion, the future occupant is himself to use his artistic sense and personal labor in welding the framework, forming the molds for the concrete, and welding domes and roofs. The functions most specially farmed out to professionals, carpentry, plastering and wiring, would be virtually eliminated or considerably reduced, but with a much larger farming-out to skilled labor of bulldozing and the pouring of concrete. While this is no place to present such a design in detail, the principle is important enough to warrant this discursion.)

Another place in which there might seem to be an ascending evolution is in the locus of on-going attention and supervision: for instance, from the particulars to a more general form of supervision, say, as between driving-- and having to start-- a very old car, with all sorts of bothersome details to be attended to, and driving a newer machine with automatic devices. But this seems to us also specious. The loci of supervision depend entirely on the particulars of the system choice made; and the use of computers and high-sensitivity and high-integration controls may be more or less reasonable depending on all the characteristics of the system. Overall planning, too, may be eliminated if there is a reasonable expectation that decentralized functions will work out best.

To talk about "advanced" systems may be quite misleading, then. Systems may "advance" to archaic states, for instance by collecting all the research scientists in a company at one particular place where they walk to their laboratories and to see each other, and find it easier to talk in person than over the telephone.

SYSTEMS ANALYSIS.

[illegible] system [illegible].

[illegible]

[illegible]

Note: Systems design etc:

SENSITIVE CYBERNETIC CIRCUITS & GENERALIZED MEDIA ARE ONLY SPECIAL CASES OF REACTING INTERLOCK.

[illegible]

[illegible] media:

[illegible] & MEDIA

EXPECTED VALUE

HISTORICAL [illegible]

AVERAGES

SUMMARY [illegible], etc.

[illegible]ING

[illegible] what [illegible]?

[illegible]

UTILITY ESTIMATE & EXPECTED VALUE

[No mention of] Systems' differential suitability and adaptability for various contingencies or changes in the world. [Leave that for next draft.]

45

The obvious first case is the evolutionary transition, wherein one system becomes another by slow changes.

(Phasing, as we have discussed it, is the attempt to plan such slow change.)

The other is the discontinuous transition, between two different phases of system development. The discontinuity here must be measured in terms of some other model of evolution, for we do not wish to imply that "service" by the system has to stop altogether, or that there is a necessary sequence in which some step is being eliminated.

The discontinuous transition of systems which occurs when interlock relations are drastically changed: that is, properties of component A, a_1, a_2, a_3... ... a_n no longer interact with properties of component B, b_1, b_2, b_3... b_n, but rather some new component X has entered the field, displacing or ignoring B, and interacting with components a_{n+1}, a_{n+2}... a_m.

That such changes in interactive structure take place cannot be questioned. The prime example is in ecology, where an evolutionary change producing drastically different behavior by the organism proves itself well suited to environmental conditions. (This is the transition from one ecological niche to another.) Examples from systems analysis and design research are less obvious; but we would cite, for instance, the eating of toothpaste sandwiches in Africa, the vast uses that have been found for polyethylene, and the possibilities of making a "leap" in the underdeveloped nations from no education to full education with the use of full-scale teaching-machine systems.

[illegible] IMPLICATIONS

[illegible]

FEATURE
[illegible] FEATURE
[illegible]

[illegible] things [illegible] automatic [illegible] on size, shape [illegible] other things.

NEW [illegible] much less automatic. [illegible] shape [illegible] with [illegible] integration of [illegible]

[illegible]

[illegible]

[illegible]

'SYNOPSIS'

Now let us turn to the older notion of design and invention. It is nostalgic, and only that, to think of designing a thing without reference to the universe in which it will be used. "Synopsis," as we have used the term, is the act of trying to take that universe into account,

However, there are cases in which synopsis of this kind will be unnecessary or trivial.

FITTING INTO THE EXISTING SYSTEM

In the design of a new motorcycle or automobile, for instance, the existing system-- that of roads, traffic control and the conventional use of such machines-- will dovetail adequately with the new. (In other cases, of course, excellent machines bring into existence complementary system components-- for instance, the telegraph, the phonograph, and telephone. In still other cases, the machine will bring an evolution of system components to catch up with it-- as the automobile did when introduced.)

LEADING DECISION

Sometimes, however, as in the air-traffic example, there are no radical departures involved. Rather, a decision will be made-- a "leading" decision-- which will influence further development of the system, by its choice of some type of interlock (as in the radio beacon systems now used by airports,) or the choice of some module of measurement-- a radio frequency, a dimension of file card, or the speed 33 1/3 for a phonograph turntable. (Even if there are radical departures involved, they may be radical departures in different directions-- like the choice of the Fleet Ballistic Missile over the B-70 bomber, if they were ever alternatives.)

In these examples we have sought to emphasize certain things: synopsis, interlock, dovetailing and modularity. Let us now discuss them explicitly.

Synopsis is the gathering of every relevant possibility into the design of a system. Naturally, there are cases in which possibilities are ruled out or ignored. We may regard them as special cases; they will come to our attention later.

Modularity in the design of things

[illegible]

Dovetailing is the interrelation of system components in such a way that features of one will complement particular features of the other. More passive than interlock, it is the fitting together of objects within the system.

Interlock is the integration of system components in such that behaviors by one will be responded to by behaviors of another. In our civil-aviation example, the interlocking objects are procedures, machines, and human supervision. They are capable of handling contingencies of high intricacy.

The three procedures may be regarded as increasing degrees of matching and fitting, of which "interlock" is the most general case.

(When we speak of fixed units of measurement to which similar things conform, we will call it modularity; this, we believe, conforms to usage in such areas as architecture and instrument planning. When dissimilar objects act with reference to things of fixed measurements (such as the cranes, ships and trains,) we will speak of the more general dovetailing.)

The packaging system of fixed-size containers is, of course, a paradigmatic case of dovetailing. All components have been made to complement one another. While there are few signals or compensations made by one unit for another, they can be conveniently treated as peas in a pod.

3) Enemy missiles. From what is known in bomb physics, ballistics, rocketry, command control, and other applied sciences, what possible approaches could be made? A preliminary analysis (omitting strategic possibilities involving strikes against the enemy) might suggest some means be sought for neutralizing the warhead, either in transit or at detonation, and anti-aircraft and anti-missile devices to destroy the enemy missile before it reached the target; and improved civil defenses. Let us follow one such possibility, the Counterweapon against

the striking device. The Nike system is such a counterweapon. Why is it called a system? In the advertisements it seems like a simple rocket. However, in fact the Nike is a collection of interacting devices, of which the rocket is only the last part. There is a general scanning radar, which sweeps an area of the sky until it finds an aggressor vehicle; there are pinpointing radars, which make an accurate fix on the aggressor and guide the rocket to it; and lastly there is the rocket itself. Further considerations show the extent to which the Nike may be called a "system." The Nike was designed in several stages, the "Nike-   ", the "Nike-Zeus" and the "Nike-Hercules." Each of these was "phased" to fit both the money available for its development, and the expected development of war technology at the time it would be ready. Thus the Nike-Hercules, ~~the~~ machine for intercepting the intercontinental missile, ~~is in its~~ it is in late stages of development as a It is not a radical departure from the previous Nike-systems, but rather a further development. When the Nike system was given its original approval, these possibilities of phased development were a part of the plan. It should be seen from this example what a range of things the systems developer must deal with.

1) Cargo is something that is going from one place to another. Under old systems of cargo handling, it was packed in whatever containers seemed most appropriate. Bicycles were packed in long rectangular cartons; household goods in cartons and crates designed for the particular object; and so forth.

The disadvantages of the system deserve special comment. Individual units were damaged or allowed to rot by careless warehousing in transit; the cost of changing transport, as from train to truck to ship, handling either units, palettes, netaful, etc., was exorbitant; superintendancy and inspection were costly and ineffective, partly (for one instance) becuase longshoreman considered pilferage their right by long custom.

A particular solution is now coming into extensive use, the <u>shipment</u> <u>module</u>. Certain sizes of containers are built for the shippers, with no intermediate sizes available; the empty containers are filled by the manufacturer and sealed; ~~and their~~

5

they are then transported in special ships, special railway

-- with virtually identical handling,

2) The improvement of air-traffic control involves a vast number of problems, of which the following can by no means be a full list: the quantity of air traffic; the speeds of air vehicles; the freedom and range of private lightplanes; developments and apparent possibilities in the sophistication of radar, and machine analysis of radar; the integration of radio messages on the ground; kinds of warning-beacons that might be installed on the ground, requiring special equipment in the airplanes; kinds of broadcasting equipment that might be installed in the airplanes, with corresponding equipment on the ground; bigger airports and more airports, with their growing cost and distance from metropolitan centers; the intelligibility, feasibility and enforceability of possible patterns for approach to airports and "stacking" of planes, as well as priority systems for letting them land; tail-parachutes and other devices for shortening either runways or landing time; ways of controlling ground traffic and getting planes out of the way to control ground collision; etc. The systems planner should even think now and then about telepathic control-tower crews and passengers-parachutes.

This example speaks for itself. The range of possibilities is vast. Any possible system would have repercussions for many of the aspects listed. The systems planner must satisfy himself that among all the available choices he has maximized/those things which a combination of are desirable and quantitative, permitted the most of those things which are desirable and either possible or impossible, and inversely for the undesirable things.

QENORX :SYSTEMS, MODULARITY, INTERLOCK, CUTOUT, GENERALIZED SCHEMATIC CONSIDERATIONS

There are a number of special problems to be taken into consideration when planning a system-- any system-- to do anything. We are going to discuss them.

The term "system," which many find a catchword, is not really one. Its use has grown in recent times for quite good reasons. Technological advance, the need to do many kinds of things, the cost and slowness of planning and development, and the interrelationship of things to be done, have all led to what is now called "systems" thinking. It is a generalization in scope of the range of problems the inventor-- now a systems analyst-- must consider. He must turn his mind to classes and trends of problems, calling before him all the possible alternatives; and if at last he produces one gadget, the reasons for it in relation to the whole field before him will be more carefully thought out. We wish to make the point that design and invention of the type we used to know is not somehow "more basic," but rather a special case.

These examples have been chose to illustrate several properties of system design: the synthesizing of all relevant information; leading decisions, and the choice of system components in a way to dovetail with other systems or features of the situation (of which "modularity" is a special case;) leading decisions, and choice of systems components, that "interlock" with other such decisions in some larger system.

Consider, if the notion of "systems" instead of "things" seems unclear or superfluous, the following problems:

cutting costs and losses in shipments of cargo over great distances;

2) the prevention of disasters in

in civilian airline traffic, while still permitting the greatest possible use of air travel;

3) preventing enemy ~~missiles~~ atomic attack from achieving missions of destruction in the American heartland, or mollifying their effect of these attacks;

There is no space here to analyze the problems in detail. However, let us abstract some of the interesting points in each systematic problem.

AN INTRODUCTION (mechanical)
to the study of how things act.

QΣ NORX I
(to follow again) SEE II

[illegible]

1 [illegible] and get [illegible]
Opportunities [illegible] [illegible]
2. Set up systems [illegible]

SYSTEM [illegible]
1. Set? & desiderata
THOUGH THAT [illegible] MAY EVOLVE
2. Necessary properties, etc.
3. Generalized exchanges & media
SUBSUMED BY "INTERLOCK"
HERE

3. ~~[illegible]~~ CHANGES
transition possibilities
Snaps to new situations [illegible]
systems

23. Things which __must__ maintain property (save for NORX)
[by outside rules]

NORX
Fringe ~~[illegible]~~
& extreme conditions
of a system

[illegible] categories of blame &c.
'RESPONSIBILITY?'

HUMAN LOCI
OF BECOMING
SUPERVISION
& INITIATION